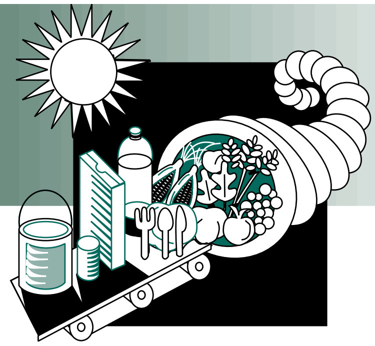
AGRICULTURE

Project Fact Sheet



PRODUCTS FROM WHEAT MILLING BY-PRODUCTS

BENEFITS

- Reduces volume of by-product waste by at least 30 percent
- Offers the potential to commercialize numerous chemical products based on a renewable feedstock
- Produces fewer emissions of CO_2, SO_2, NOx, particulates, and VOCs
- Reduces use of electricity and petroleum for processing
- Replaces petroleum as a feedstock for chemicals
- Increases value of by-product to be used as animal feed
- Alleviates the uncertainties of the wheat commodity market
- Projected 2020 target market is 340 million pounds of propylene glycol per year
- Projected 2020 fossil fuel displacement is 15.5 trillion Btu

APPLICATIONS

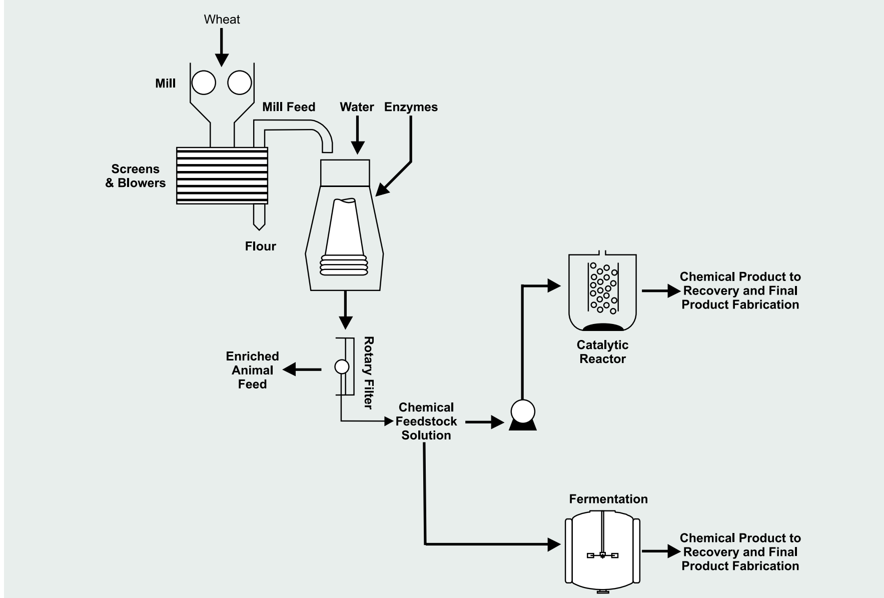
Sugar alcohols (sorbitol, mannitol) can be purified and marketed after hydrogenation of the starch or processed further to industrial oxy-chemicals. After the successful completion of the bench-scale phases of this work, Pendleton Flour Mills and the Mennel Milling Company will form a joint venture to proceed toward commercializing the technology.

MILL FEED CAN BE A SOURCE OF RENEWABLE FEEDSTOCK FOR HIGH-VALUE CHEMICALS

Mill feed is the by-product of wheat flour milling processes. About 6.5 million tons of this low-value product are used as animal feed. It may be possible to significantly upgrade the mill feed to higher value products through further processing into sugars. The sugar can be fermented to produce valuable chemicals, such as lactic acid, and used to produce biodegradable plastics. The sugars can also be converted through novel chemistry to produce propylene glycol used in antifreeze and other valuable chemicals. The material finally remaining from the mill feed has a higher protein content and is a more valuable animal feed.

When renewable plant materials are processed in an aqueous medium, significantly fewer environmental emissions of carbon dioxide, sulfur dioxide, nitrous oxides, volatile organic compounds (VOCs), and particulates are generated than during conventional chemical production. Energy use will be significantly reduced using the new processing methods. The replacement of petroleum as the feedstock for plastics and other chemical products will also reduce the demand for this resource. Wheat producers will also benefit from this research because the production of chemicals from wheat by-products will help offset the uncertainties of the wheat commodity market.

PROCESS TO CONVERT MILL FEED BY-PRODUCTS INTO VALUE-ADDED CHEMICALS



Researchers will develop processes to recover the starch fraction of mill feed and convert it to a more valuable product by either a catalytic or fermentation process.

Project Description

Goal: To develop processes for producing value-added chemical products from the starch by-product of wheat flour milling.

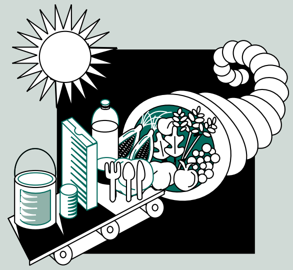
The first two years of this project will be taken up by Phase I, development of economical methods to recover starch from mill feed, and Phase II, development of cost-effective methods to convert the recovered starch product into value-added chemicals. Researchers also will analyze the feed value of the residual mill feed (after starch is removed) and of fermentation by-products, through chemical analysis and animal testing. The third year will be devoted to Phases III and IV, scale-up of the most promising technologies.

Initially, chemical analyses will be performed on mill feed from five varieties of wheat, and starch recovery tests will build on process studies already completed at Pacific Northwest National Laboratory. Aqueous processing of mill feed slurries will proceed at varying temperature, time, and pH ranges. An economic model of the starch-recovery process will be developed and refined as data becomes available.

The recovered starch-derived product will be processed catalytically in the two-step procedure of hydrogenation of sugars to sugar alcohols and hydrogenolysis of sugar alcohols to glycols and other polyols. Microbial fermentation tests will also be conducted in a computer-controlled fermentor system, controlling variables such as pH, dissolved oxygen, and mixing. Various substrates will be screened, including the mill feed, the recovered starch portion, or the sugars produced by hydrolysis of the starch, as well as known lactic acid-producing microorganisms, to determine optimal conditions for lactic acid production.

Progress and Milestones

- The economic model will be used to determine the cost-effectiveness of the starch recovery process and whether the research should proceed to Phase II.
- During Phase II, agreements will be formalized concerning the marketing and distribution of value-added products.
- At the end of Phase II, the economic model, expanded to include the catalytic and fermentation processing steps to produce value-added products, will help determine whether to proceed to Phase III.
- Phase III and IV of the project will be a scale-up of the recovery and conversion process to a pilot plant and a joint venture between the milling companies that are project partners.
- If the pilot plant is successful, a commercial facility will be designed and analyzed for cost-effectiveness before proceeding to commercialization.



Project Partners

Mennel Milling Company
Fostoria, OH

Pacific Northwest National Laboratory
Richland, WA

Pendleton Flour Mills, Inc.
Pendleton, OR

For additional information, please contact:

Douglas L. Faulkner
Office of Industrial Technologies
Phone: (202) 586-2119
Fax: (202) 586-3237
doug.faulkner@ee.doe.gov

Please send any comments, questions, or suggestions to
webmaster.oit@ee.doe.gov

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www.oit.doe.gov

Office of Industrial Technologies
Energy Efficiency
and Renewable Energy
U.S. Department of Energy
Washington, D.C. 20585

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